THE ROLE OF PIONEER SPECIES IN REVEGETATION OF DISTURBED DESERT AREAS

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Abstract.— The northern Mojave Desert, as are many deserts, is characterized in part by small "fertile islands" in which exist individual shrub clumps each containing two or more plants. These fertile sites promote characteristic organization of both plant and animal activity in the desert. Destruction of these fertile sites makes revegetation extremely difficult because most seedlings germinate in these sites. Some pioneer species do, however, germinate and survive in the bare areas between the fertile sites. Four such species in the northern Mojave Desert are *Acamptopappus shockleyi* Gray, *Lepidium fremontii* Wats., *Sphaeralcea ambigua* Gray, and *Atriplex confertifolia* (Torr. & Frem.) Wats. These four species may have a role in starting new fertile islands.

Mojave Desert Characteristics

Revegetation procedures have been studied for some years by our group as a means of land reclamation of disturbed desert areas (Romney et al. 1971, Wallace and Romney 1975, 1976, Wallace and Romney, 1972a, 1972b, Wallace et al. 1977). The revegetation process is ordinarily slow, partly because the low rainfall in many years just will not support the establishment of new seedlings. A more important reason, however, is that the soil surface becomes organized as a result of prior plant activity, which results in microwatersheds. When this basic structure is destroyed, revegetation is extremely difficult to achieve either naturally or by manipulation.

Rainfall in the Mojave Desert is enough to support only a small amount of vegetation. An interesting feature of this desert is that just part of the soil surface (10 to 20 percent) is generally occupied by clumps of growing plants, and the other 80 percent to 90 percent serves mainly as watershed for the 10 to 20 percent of area supporting vegetation (Charley 1972, Romney et al. 1977, Garcia-Moya and McKell 1970). The land surface structure has been in place for decades, or centuries (Wallace and Romney 1972b), and has resulted in the soil beneath shrub clumps becoming very fertile areas that compare favorably with agricultural soils or those of grassland or forest ecosystems. The fertile areas are high in soil organic materials and available nutrients. Roots of plants in the fertile shrub clumps extend outward into the bare areas so that the soil moisture of the total land area potentially becomes available to the clumps. This system is much more efficient in sustaining plants than would a system in which the soil organic matter and readily available nutrients are uniformly distributed throughout the whole soil area but at a much lower level. That condition would result in much nitrogen deficiency.

Role of Pioneer Shrub Species

The bare desert soil between shrub clumps generally is low in organic materials, and it characteristically has an unfavorable soil structure (less aeration) that tends to inhibit the establishment of new seedlings as well as the growth of other plants. Plant species that are capable of invading bare areas, especially when sufficient soil moisture is available, must be adapted to conditions related to poor soil structure and low organic matter.

When land disturbance destroys these fertile islands, it is well known that the natural revegetation problem is formidable (Wallace and Romney 1975, Wallace et al. 1977). There are some common perennial species in the northern Mojave Desert, however, which

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are able to pioneer by growing in the less fertile bare areas. Somehow they obtain sufficient N, but likely not through fixation of atmospheric N_2 (Hunter et al. 1977). They also obtain sufficient other nutrients, and they must be adapted to growth in soil of poor structure. Four such species are *Acamptopappus shockleyi* Gray, *Lepidium fremontii* Wats., *Sphaeralcea ambigua* Gray, and *Atriplex confertifolia* (Torr. & Frem.) Wats. The latter is ubiquitous in the western deserts. The encouragement of these species to grow on disturbed sites and studies to help make this possible are of urgent priority if revegetation required by land restoration legislation is to be achieved successfully in the northern Mojave Desert. It is of considerable importance to learn the nutrient status, water and oxygen requirements, and other ecological behavior characteristics of these four pioneer species that can help solve land reclamation problems.

A Case History

In 1967, at Mercury, Nevada, a site 18 m in diameter was cleared of vegetation. The main crown roots of the plants were removed, but the fertile islands were not destroyed. The original purpose was to change the soil moisture status. After nine years, on 28 May 1976, the following numbers of invading perennial plants were counted in the plot: 14 *Ceratoides lanata* (Pursh) J. T. Howell, 4 *Lycium andersonii* A. Gray, 33 *A. shockleyi*, 26 *L. fremontii*, 4 *Ambrosia dumosa* (A. Gray) Payne, 3 *Machaeranthera tortifolia* (A. Gray) Cronq & Deck, 6 *Oryzopsis hymenoides* (Roem. & Schlt.) Ricker, 18 *S. ambigua*, 2 *Sitanion jubatum* J. G. Sm., and 2 *Krameria parvifolia* Benth. No *L. fremontii* were involved in the adjacent nondisturbed area, but plants for seed stock were located in a nearby wash. Seventy-three percent of the invading perennial plants in this plot were of the species defined above as pioneer species, and they were the only ones that were found in the original bare areas between the fertile islands. Most of the other new plants had invaded the old fertile island sites. Very few annuals were present in the nondisturbed areas, but some were found in the cleared area.

Atriplex confertifolia was not found at or near this particular test plot area, but we have observed its pioneering capabilities at a number of disturbed sites located elsewhere around the Nevada Test Site.

Acamptopappus shockleyi can survive for a number of years. On a particular site where 29 seedlings were observed eight years earlier, 21 of them were still surviving in 1976. The mortality after the eight years was 28 percent.

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